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WATERSHED WORK PLAN
LOW SWAMP WATERSHED
BAMBERG AND COLLETON COUNTIES
SOUTH CAROLINA

1964
SOUTH CAROLINA



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

JANUARY 1964

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WATERSHED WORK PLAN

WILLOW SWAMP WATERSHED

BAMBERG AND COLLETON COUNTIES

SOUTH CAROLINA

Prepared under the Authority of the Watershed
Protection and Flood Prevention Act (Public
Law 566, 83d Congress, 68 Stat. 666) as amend-
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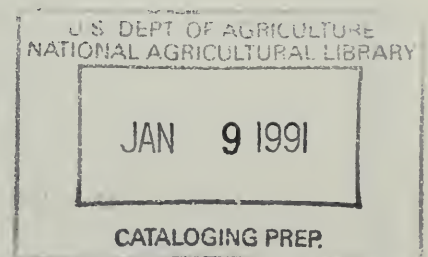
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Colleton Soil Conservation District
Willow Swamp Watershed Conservation District

With Assistance By:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

JANUARY 1964



THE UNIVERSITY OF CHICAGO

DEPARTMENT OF CHEMISTRY

LABORATORY OF ORGANIC CHEMISTRY

CHICAGO, ILL.

REPORT OF THE PROGRESS OF THE
LABORATORY OF ORGANIC CHEMISTRY
DURING THE YEAR 1927

BY
ROBERT M. BROWN, JR.
AND
JAMES E. HARRIS

CHICAGO, ILL.

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THE WATERSHED WORK PLAN

WILLOW SWAMP WATERSHED

BAMBERG AND COLLETON COUNTIES, SOUTH CAROLINA

SUMMARY OF PLAN

The Willow Swamp Watershed, with an area of 33,282 acres, is located in Bamberg and Colleton Counties, South Carolina. It lies in one of the flatter portions of the Atlantic Coastal Plain province. The sponsoring local organizations are the Edisto and Colleton Soil Conservation Districts and the Willow Swamp Watershed Conservation District.

The principal watershed problems are flood damage to crops and pasture and to roads and the lack of outlets for drainage.

The objectives of the sponsoring local organizations are (1) the reduction of flooding to a point where damaging floods will occur not oftener than once in five years with the exception of the Moselle, Cedar, and Rum Gully Swamp areas for which a two-year level of protection is desired, (2) the construction of multiple purpose channels of sufficient depth and capacity for flood prevention and drainage, and (3) application of the needed land treatment measures. The measures included in this work plan will satisfy all of these objectives.

Land treatment measures will include conservation cropping systems, cover and green manure crops, field windbreaks, wind stripcropping, rotation grazing, pasture planting, wildlife habitat development, tile drains, drainage field ditches, and tree planting. These measures will be installed within a five year period at a cost of \$182,411 for the realization of benefits from the project. Of this amount PL 566 will furnish \$20,126 for technical assistance. The measures will be installed, operated, and maintained by landowners and operators in cooperation with the Edisto and Colleton Soil Conservation Districts at their own expense with such assistance as may be available from other programs.

Structural measures will consist of the installation of 45.9 miles of multiple purpose channel and two dug fish lagoons to mitigate damage to fish habitat caused by the installation of the channel system. Bridges and culverts will be modified to provide capacity and depth of channels to meet project objectives. The cost of structural measures will be \$531,375. PL 566 cost will be \$387,447 and \$143,928 will be from "other" funds.

The Act to create the Willow Swamp Watershed Conservation District was passed by the South Carolina Legislature in February, 1962. The referendum held on March 13, 1962, was favorable with only one dissenting vote. The Act provides for a second referendum intended to grant the power of additional taxation to amortize the bond issue which would finance local costs of structural measures. Tax levies on the lands in the watershed will be graduated on the basis of the extent to which benefits from the project may be expected.

Structural measures will be installed under contracts administered by the Willow Swamp Watershed Conservation District. The Watershed District will assume responsibility for providing the local share of the construction cost and for the operation and maintenance of the works of improvement. The estimated average annual cost of operation and maintenance of the structural works of improvement is \$16,600. Funds for the local share of construction cost and for operation and maintenance will be realized from tax levies on real property.

Installation of the planned structural measures will benefit 14,667 acres of land. These benefits will accrue on lands of 70 farms.

The estimated average annual primary benefits are \$88,888 and the average annual cost of the works of improvement will be \$37,254.

The ratio of benefits to costs will be 2.4 to 1.0.

This project will make a significant contribution to needed land use adjustments, will increase farm efficiency, and contribute to community development. Any increase in feed grain will be used locally.

This project will be installed by the local sponsoring organizations with assistance from the Forest Service and the Soil Conservation Service under the provisions of PL 566, as amended.

DESCRIPTION OF THE WATERSHED

Physical Data

Location - The Willow Swamp Watershed comprises an area of 33,282 acres in Bamberg and Colleton Counties, South Carolina. A portion of the Town of Ehrhardt and the Towns of Lodge and Ashton are in the watershed. The City of Bamberg lies about 13 miles to the north and Walterboro is about 20 miles to the southeast.

Climate - Records of the U. S. Weather Bureau for the station at Yemassee, S. C., give the average annual rainfall as 48.44 inches. Mean temperature for January is 50.6° F and for July, 80.5° F. The normal growing season between frosts is 204 days.

Physiography and Geology - The watershed lies in the Coastal Plain province in an area in which the landscape is relatively featureless. In general, relief is slight around the upper watershed boundary and becomes more pronounced as the lower end is approached. There are, however, two distinct areas. The first is made up of broad, flat bench lands which are found around the perimeter of the watershed. The other comprises the broad, flat swampy areas of the main stem of Willow Swamp and some of its tributaries. The bench lands usually lie several feet above the swamps and the transition between the two areas is often quite abrupt.

Comparisons between average elevations of fields now being used and the bottoms of existing stream channels show a difference of about two feet at the upper ends of mains numbered 1 and 2.

On Willow Swamp about one mile below S. C. State Highway Number 641, this comparison increases to eighteen feet. The larger difference illustrates the fact that there is no need for channel work in areas of this type to provide outlets for the lands lying at higher elevations.

Underlying formations are the Cooper marl of Eocene age and the Hawthorn of Miocene age. The contact between these formations is believed to extend in a general east-west direction along a line that passes near the Town of Lodge. These formations are capped by a mantle of Pleistocene sands and clays.

Soils - Soils are fairly evenly divided between the sandy loams and the lighter-textured loamy sands and sands. The sandy loams are mostly of the Goldsboro, Lynchburg, Rain, and Portsmouth series. The loamy sands and sands are predominantly Lakeland, Klej, Scranton, Norfolk, Plummer, and Rutledge. The sands are predominant in the area around Ashton and to the southwest. The rest of the watershed is predominantly sandy loams (15% to 20% inclusions of loamy sands.)

The low-lying areas along the streams belong to the same soil families as the adjacent higher soils. They differ in that those along the streams are predominately poorly to very poorly drained whereas the soils on the bench lands are somewhat poorly to well drained.

It should be noted that the low-lying areas along the streams are sometimes affected by alluvial deposits. This is particularly true when the draws are narrow and the adjoining slopes are steep.

About 80 percent of the land in the watershed carries a "w" classification which indicates the need for flood prevention and drainage. Some 60 percent of the land falls into classes IIw and IIIw. Both of these are desirable land classes with good agricultural capability when drained and protected from flooding.

Land Use and Cover - Land use in the watershed includes 8,986 acres of cropland, 15,250 acres of woods, 4,492 acres of pasture and idle, and, 1,325 acres of miscellaneous. All of the cropland and pasture is located on the higher lands which are well adapted for these uses. Nearly all of the low lying areas along the main stem and major tributaries are in woods, mostly swampy hardwoods. This is the best use for this area.

Vegetative cover on the land is, in general, excellent. There are no denuded areas and pastures are not overgrazed.

Water Courses - The drainage pattern is dendritic with the flow of Willow Swamp being in a southeasterly direction to the confluence of Willow Swamp and the Little Salkehatchie River at the lower extremity of the watershed. Poorly defined and braided channels are common.

Forestry - Some 2,400 of the 15,250 acres of woodland are owned by private companies. The remainder is in relatively small holdings on farms. The major forest types are pine, 31 percent; pine-hardwood, 11 percent; hardwood-pine, 20 percent; and hardwood, 38 percent. Site index for slash pine averages 85 in areas with adequate water control and 75 in areas with excess water. The present level of forest fire protection is adequate.

Fish and Wildlife

Present fish species found in the watershed include large-mouth bass, jack blue gill, catfish, green sunfish, pumpkinseed, suckers, mudfish, gar and miscellaneous minnows. Some of these fish migrate to the extreme upper reaches of the tributaries for the spawning season. The area does not offer very much fishing due to the lack of suitable access. Fallen trees, brush and other vegetation restricts the number of fishing "holes".

Economic Data

Farms in the watershed range in size from 75 to 450 acres. The typical farm contains an area of about 250 acres and is valued at \$25,000. The present market value of farm land, including woodland, open land, buildings, and improvements, is about \$100 per acre. There are 135 farms in the watershed, most of them operated by owners.

Markets are easily reached by highways and roads. Most of the farm products are marketed within short distances.

Principal crops produced, in order of importance to the economy, are corn,

soybeans, small grain, cotton, and tobacco. There are several sizeable dairy farms. It is estimated that 90 percent of the total income in the watershed is from agriculture.

Forest products are produced in moderate quantity and most of the forest land is owned by farmers. There are no National Forest lands in the watershed.

Both Bamberg and Colleton Counties were designated Rural Areas Development Counties under the Area Redevelopment Act of 1961. It is expected that farm income in the watershed will be greatly improved by the project since a very high percent of the total income is from Agriculture. The 1959 U. S. Census of Agriculture, adjusted to the watershed, shows that only 33 percent of the farms are considered as commercial farms. This indicates that 67 percent of the farms in the watershed are non-commercial and had total sales of less than \$2,500.

Other census data on commercial farms, adjusted, divides them into six economic classes on the basis of the total value of all farm products sold, as follows:

<u>Class of Farm</u>	<u>Value of Farm Products Sold</u>	<u>Percentage of Farms by Economic Class in Watershed</u>
Class I	\$40,000 and over	1.2
Class II	\$20,000 to \$39,999	1.1
Class III	\$10,000 to \$19,999	9.2
Class IV	\$ 5,000 to \$ 9,999	9.6
Class V	\$ 2,500 to \$ 4,999	25.9
Class VI	\$ 50 to \$ 2,499	53.0

These data show that a high percent of the farms in the watershed had total sales of less than \$2,500 even though classified as commercial.

WATERSHED PROBLEMS

Of the bench areas, there are 14,667 acres of land in the watershed that have both water management and flooding problems. On these lands the two problems are inseparable. There are another 14,400 acres of land area on which these problems do not exist to the extent to require project action. The latter segment is generally in the interior of the watershed and lies at a lower elevation

than the bench land and at a higher elevation than the low areas along Willow Swamp and its principal tributaries.

Floodwater Damage

Natural channels of low capacity and a water table in close proximity to the land surface are characteristic of this watershed. In the areas where channel work is planned the land surfaces are flat to very gently sloping. Whenever unusual precipitation occurs, flooding of these flat areas is certain. The most intense rains occur in July and August when tobacco, corn and other summer crops are maturing.

There are 4,100 acres of open land in the watershed that are flooded an average of from two to three times annually. This limits intensive farming involving high-return crops to the very highest land. Artificial means of removing surface water are necessary to reduce the extent and duration of flooding so that all of the land may be utilized profitably.

Some public roads in the watershed suffer flood damage as much as several times a year. This results in great inconvenience and expensive repairs.

On pine sites on forest lands, the frequency and duration of the flood periods not only retard the growth of existing pine stands, but often prevent the germination and survival of pine needed for the establishment of new stands. In the pine lands, the presence of excess water prohibits the economical harvesting of pulpwood, gum and timber from large areas during most of the year. The site index for slash pine on the flooded areas averages 75. On comparable soils with better drainage the site index for this species is 85.

Agricultural Water Management

The land subject to flood damage also needs drainage for most economical production. This land is mostly in capability classes IIw and IIIw with smaller amounts in other "w" classifications. While most of the farms are served by some system of on-farm drainage, these facilities are inadequate for the most part, except during unusually dry years.

Quality of crops and yields from improperly drained areas are substantially lower than on well drained areas of the watershed. Poor crop stands and inability to perform proper cultivation cause low yields. Abnormally wet soil condition also prevents the operation of farm machinery during harvest seasons. This results in increased crop costs.

The problem of drainage and flooding are invariably present on the same land. In the flat areas where no definite drainage pattern is present, outlets are not available and flooding of the lowest areas on a frequent basis is certain. The main runs of Willow Swamp, Fender Creek and McCuren Branch (see Project map) are located in depressed swamp areas well below the level of nearby farm land now being used for crops and pasture. This difference in elevation provides ample outlets for farm land in these areas. No channel excavation or clearing is necessary along these streams. The system of channel shown on project map is located in flat areas where there is a definite need for channel outlets for flood prevention and drainage.

Health Conditions

The large amount of standing water and moist conditions in the watershed is conducive to the breeding of mosquitoes. The high water table and frequent flooding are detrimental to the proper functioning of septic tanks.

Erosion Damage

Wind erosion in the larger fields is significant and requires some control measures. Moderate sheet erosion is occurring in the areas along the Willow Swamp drainageway where slopes become slight. Sediment damage to crops is of little consequence.

PROJECTS OF OTHER AGENCIES

There are no existing or proposed works of improvement which would affect or be affected by the structural works of improvement to be installed by this project. The Edisto and Colleton Soil Conservation Districts, the South Carolina State Forestry Commission, the State Extension Service, the Farmers Home Admin-

istration and the Agricultural Stabilization Service programs will all help farmers with the application of land treatment measures.

Sixty-eight basic farm conservation plans have been prepared by landowners in cooperation with the Edisto and Colleton Soil Conservation Districts and four of these have had all conservation measures installed. It is planned that the watershed program will be coordinated with all going programs to facilitate the accomplishment of the project objectives.

BASIS FOR PROJECT FORMULATION

The objectives of the sponsoring local organizations as first given included drainage outlets to accommodate tile, a five-year level of protection against flooding with maximum use being made of floodwater retarding structures which were to include water for irrigation.

A preliminary study revealed that the soil conditions and the high water table in the watershed would make ditch depths greater than about five feet impractical.

Also, that the topography would not provide enough stroage for floodwater retarding structures anywhere in the watershed area nor was there a need found for these structures. Observations and studies indicated that the lack of flowing water in dry seasons would result in reduced water levels in reservoirs. This questionable recharge at times when the irrigation water would be required, indicated that reservoirs dug below ground surface would be much more practical.

During a conference with representatives of the local sponsoring organizations, it was decided to amend the watershed objectives by deleting the request for tile outlets (7' depth canals) and irrigation as a purpose. At the same time, recreation was included in the objectives and the planning party was asked to investigate two possible dam sites.

Since the Moselle, Cedar, and Rum Gully Swamp areas contain some hardwood sites that might be damaged by a five-year level of flood protection, the channel work in this area is based upon a two-year level of protection. This

amount of reduction in water level should not affect the swamp hardwoods, but will allow development of the suitable pine sites in and along the swamp area. No other water control measures were deemed necessary.

Later, it was found that drainage and flood prevention channels would not be required except in some swamped-out areas and in the flat land adjacent to the upper watershed boundary. This resulted in the planned system of channels which will remove runoff from a five-year frequency twenty-four-hour rainfall in twenty-four hours except in Moselle, Cedar, and Rum Gully Swamps. Channels there will remove the runoff from a two-year frequency twenty-four hour rainfall in forty-eight hours. Many impractical aspects and the difficulty of obtaining easements for the recreation impoundment led to its abandonment.

Two fish lagoons were included to mitigate damages to the fish habitat as a result of the proposed channel improvement. Fish now migrate to the upper reaches of the tributaries to spawn. Since the proposed channel improvement will impair the present spawning areas it was necessary to include the two lagoons in order to preserve a spawning area for these species. Biologists of the SCS and of the U. S. Fish and Wildlife Service made the determination as to need and benefit of these lagoons.

This plan will meet the project objectives by providing flood prevention and drainage benefits to the portions of the terrace areas on which flooding and drainage problems now exist. Each channel will be extended far enough beyond the break between the bench area and the swamp area to insure an adequate outlet. Although there are minor flooding and drainage problems in the remainder of the terrace area, project action is not necessary. Present outlets are adequate to permit individual landowners to install needed ditches. No works of improvement are planned for the swampy areas along the main stem and some of the major tributaries since none are needed here for the planned works of improvement to function successfully. The sponsors do not feel that it would be feasible to install channel improvement through this swampy area which is now in swampy

hardwoods. This is the best use for this area. The local sponsoring organizations are agreeable to the acceptance of the protection as explained in this section.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The objectives of the Willow Swamp Watershed project are flood prevention, agricultural water management (drainage) and soil and water conservation. An effective land treatment program must be applied to the land if these objectives are to be met.

Over sixty percent of the land in the watershed is in IIw and IIIw classes. This is very desirable farm land but needs flood prevention, drainage and other conservation practices.

The differences in soils and topography clearly indicate the need for planning and applying an intensive land treatment program that will control runoff and erosion, provide better drainage and improve soil conditions. In selecting land treatment measures, consideration was given to the type and intensity of conservation problems, overall project objectives and the type of farming being followed in the area. In developing conservation farm plans landowners can utilize alternative combinations of measures which will not only help accomplish project objectives but will also be consistent with their individual needs and desires as well as their physical and economic resources.

In order to apply an effective land treatment program a good conservation farm planning job must be done. A study of conservation needs showed at least 65 cooperators will have to develop new complete soil and water conservation farm plans. In addition to the new plans a minimum of 32 old basic soil and water conservation farm plans will have to be rewritten.

In the development of these plans vegetative practices will be used in combination with structural measures in order to reduce runoff, provide protection from erosion, improve drainage and general soil conditions. Conservation crop-

ping systems will be planned and applied so that crops will be grown on soils for which they are best adapted. Row crops, particularly soil depleting crops, will not be grown more often than soil capabilities will allow.

Other land treatment measures will include wind strip-cropping, field wind-breaks, cover and green manure crops, rotation grazing, pasture planting, wildlife habitat development, tile drains where outlets are available, drainage field ditches, tree planting, and hydrologic stand improvement in woodland.

Hydrologic stand improvement will include the selection of low-value trees to chemically treat, thereby releasing the preferred species; and the modification of harvesting methods, cutting cycles, and woodland management plans, so that they will contribute to improved hydrologic conditions.

No significant changes in kinds of crops are expected to occur during the life of the project. However, as a result of farm planning and improved drainage there will probably be some shifting of cultivation to more desirable fields.

The land treatment program must be planned and applied if project objectives are to be met successfully. It must also be maintained to protect and improve the land and insure the continual effective functioning of structural measures.

Structural Measures

Structural measures to be installed consist of 242,352 lineal feet of multiple purpose channel for flood prevention and drainage and two fish lagoons. The estimated cost is \$531,375 of which \$387,447 will be paid from PL 566 funds and \$143,928 from other funds.

Bridges and culverts will be modified to provide capacity and depth of channels to meet project objectives. Spoil banks will be shaped and seeded. Pipe overfalls supported by sand-cement bag walls will be installed where necessary at road crossings. At other locations, pipe overfalls or spur inlets will be constructed from the channel to the right-of-way line as required to convey water through the spoil into the channel. The system of channels is planned to accomplish the project objective and is designed to give every part

of the watershed the necessary outlets for on-farm drainage and group laterals.

The two proposed fish lagoons will be 20 feet by 300 feet bottom measurements and will be dug five feet deeper than the channels to which they are connected. Since the lagoons are mitigating measures, they are considered as part of the channel system. The real affect of this type of installation can only be estimated at the present time. However, it is felt that these lagoons will have considerable affect on fish habitat.

Channels in the Moselle, Cedar, and Rum Gully Swamp areas were designed on the basis of the formula: $Q=25M^5/6$, and for the remainder of the channels in the watershed, the constant was increased to seventy-four.

For details of quantities, costs and design features of structural measures refer to Tables 1, 2 and 3. Location of structural measures is indicated on the Project Map (Page 38).

EXPLANATION OF INSTALLATION COSTS

Land treatment measures are estimated to cost \$182,411. The PL 566 cost of \$20,126 will provide two and one-half man years of additional technical assistance to accelerate the planning and application of these measures. It is estimated that \$9,750 is now being spent in the watershed for technical assistance by the Soil Conservation Service during an average five year period.

The cost of land treatment measures is based on average figures now being used in Bamberg and Colleton Counties.

The installation costs of structural measures shown in Tables 1 and 2 are based on the best information obtainable but must be considered as approximate. The engineering estimate is based on unit costs arrived at by averaging figures supplied by several contractors and several Soil Conservation Service engineers who are working in coastal plain areas of South Carolina. The construction cost estimate includes clearing a right-of-way, excavation of the channel and spur inlets, spreading the spoil on both sides, construction of pipe overfalls where necessary, planting suitable vegetation on the shaped spoil, excavation of two

mitigating fish lagoons and a twelve percent contingency fee.

Installation services include the cost of engineering, supervision, and the administration of construction of the structural works of improvement. These figures are estimated on the basis of past experience.

The cost of administration of contracts and the value of easements and rights-of-way are listed under other funds since they are local costs. The cost of the administration of contracts is an estimated figure including fiscal, clerical, and legal assistance as well as office supplies required for advertising for bids, letting the contract, and administrative cost of paying for the structural measures as the work progresses.

The value of easements was furnished by the local sponsoring organizations. These figures are \$50 per acre for the wooded swamp land and \$100 per acre for the land that may be drained economically for use as pasture or cultivated crops. Changes required in bridges and culverts to provide capacity and depth to the channel system are included in the easement and right-of-way item.

Construction cost of the multiple purpose channel improvement for flood prevention and drainage and the mitigating fish lagoons is estimated to be \$360,332. Flood prevention was allocated \$213,677 and drainage \$146,655. (See Page 35) The proposed sharing of installation costs of structural measures is \$387,447 (72.9%) from PL 566 funds and \$143,928 (27.1%) from other funds. This cost sharing was arrived at by first allocating costs of the multiple purpose channel improvement to the two purposes (flood prevention and agricultural water management) in accordance with the method prescribed in paragraph 1132.212h of the Watershed Protection Handbook.

Since the two lagoons are being installed to mitigate damages caused by the installation of the channel system, their cost sharing is figured on the same basis as the channels. For further details of cost allocations, see Economic section of Investigation and Analyses.

In the operations stage, additional surveys and borings will be made to more

completely analyze conditions and furnish a better basis for the final design of structural measures.

The expected expenditures in accordance with the anticipated schedule of operations are as follows:

<u>Year</u>	<u>PL 566</u>	<u>Other</u>	<u>Total</u>
First	\$ 4,025	\$ 32,457	\$ 36,482
Second	391,472	176,385	567,857
Third	4,025	32,457	36,482
Fourth	4,025	32,457	36,482
Fifth	<u>4,026</u>	<u>32,457</u>	<u>36,483</u>
Total	\$407,573	\$306,213	\$713,786

EFFECTS OF WORKS OF IMPROVEMENT

Project objectives as agreed upon by the local people are stated in the section entitled "Basis for Project Formulation".

Installation of planned works of improvement will benefit 14,667 acres. Monetary benefits were claimed on 8,372 acres and the project is justified without increasing the acreage of crops in surplus supply. The current average price of this land is estimated to be \$80 per acre.

The proposed system of channels will provide adequate drainage outlets where they are needed. Landowners indicate intentions of installing additional on-farm and small group drainage ditches necessary for the realization of benefits. Improved drainage will facilitate more timely performance of cultural practices essential to efficient farming.

Structural measures will benefit 70 farms in the watershed. The benefits are primarily in the form of reduced flood damage, improved drainage, decreased production costs, increased yields of higher quality and better health conditions.

The planned channel improvement in the Moselle, Cedar, and Rum Gully Swamp areas will provide two-year flood protection which is adequate since most of this area is in woods. This will eliminate the long periods of inundation and

saturated soil conditions that occur each year in the near level forest lands. It will do this by providing adequate outlets and thereby remove the excess surface water within a period of time suitable for good growth and reproduction of the desired tree species. The reduced frequency and duration of floods will permit the germination and survival of new stands. It will also permit the economical harvesting of pulpwood, gum and timber from large areas during most of the year.

Data from the 1959 U. S. Census of Agriculture, adjusted, show that a high percent of the farms in this watershed had total sales of less than \$2,500. The effects of the project on these family owned and operated farms will be significant. The installation of proposed structural works of improvement, together with on-farm drainage measures, will increase economic opportunities for many of these low-income families. Farm operators can make needed land use adjustments that will be more in line with capabilities and needs of the land. Changes in land use on the benefited land will not increase the acreage of allotted crops in the watershed. Increased production is needed for balancing the farm enterprise and little or none of the increase will get into economic channels. Increased income resulting from such production will make a needed contribution to the objectives of rural area development.

Many farmers stated that the problem of inadequate outlets for farm drains prevented or delayed land preparation and planting. Likewise, harvesting is delayed and in some cases harvesting with machinery is prevented. The results have been poor yields of poor quality. The project will permit more timely performance of farm operations, thus increasing farm efficiency and permitting better farm management.

In addition to increasing economic opportunities for low-income families the project is expected to have a favorable influence on the economy of the local community. These secondary benefits accrue as a result of increased

income from transporting, processing, and marketing of those goods and services that produce the primary benefits, and from supplying additional materials to farmers.

The installation and operation maintenance of project measures will also provide employment opportunities for the unemployed or underemployed labor in this area. The estimated value of such employment was included in the benefit-cost ratio.

Proposed outlets for the channelwork will be in natural drainageways. There will not be any significant stage increases in these depressed swamp areas due to the proposed system of channels.

It is expected that the loss of fishing waters due to installation of channel will be small. However, following channelization, favorable fish habitat will not exist. It is believed that the two proposed fish lagoons should be constructed as a partial mitigation measure. Although small in size, it is felt that they will provide some fish habitat. Also they will serve as locations to hold fish upstream during periods of little flow in channelized runs.

PROJECT BENEFITS

It is not possible to make a physical separation of flood prevention and drainage benefits on the 4,772 acres of crop and pasture land and 3,600 acres of forest land, on which benefits are claimed, because floodwater and drainage problems exist on the same land. These benefits are considered as joint land enhancement benefits. The estimated average annual primary benefits to crops, pasture, and forest land amount to \$85,478. (See page 36)

This watershed is located in Rural Areas Development Counties designated under the Area Redevelopment Act. Redevelopment benefits resulting from the income provided to unemployed and under-employed labor during project installation and operation and maintenance (limited to 20-year period on O&M) are estimated to amount to \$3,410 annually.

Average annual secondary benefits, not used in project justification, are

estimated to be \$15,162. These benefits will accrue to processors and handlers as a result of increased production and to local business as a result of increased income.

The affects of the fish lagoons are entirely mitigating, and are intended to compensate for damages to fish habitat caused by the installation of the channel system. These dug-out reservoirs do not in any manner cause enhancement benefits but are mitigating in that they are expected to partially compensate for damage to fish habitat.

COMPARISON OF BENEFITS AND COST

The average annual cost of planned structural works of improvement, including operation and maintenance costs, is estimated to be \$37,254. Estimated average annual primary benefits amount to \$88,888. The ratio of benefits to cost is 2.4 to 1.0. (Table 5, page 30)

PROJECT INSTALLATION

Land Treatment Measures

The landowners and operators will install the planned land treatment measures in cooperation with their respective Soil Conservation Districts in accordance with provisions of cooperative agreements and plans with landowners. The installation period will be five years.

Technical assistance provided by the Soil Conservation Service will be supplemented with PL 566 funds to accelerate planning and application so that the project can be completed within the designed installation period.

The South Carolina Commission of Forestry, in cooperation with the U. S. Forest Service, will provide technical supervision for installing all forestry measures.

Structural Measures

The channel improvement will be installed by contract administered by the Willow Swamp Watershed Conservation District. Plans, specifications, and the necessary engineering supervision for the installation of structural measures

will be furnished by the Soil Conservation Service.

The Willow Swamp Watershed Conservation District will be responsible for obtaining all easements and rights-of-way for structural measures and for all expenses incident thereto and for the administration of all contracts. All of the structural works of improvement will be installed during the second project year.

FINANCING PROJECT INSTALLATION

Land Treatment Measures

Installation cost of these measures (Table 1) will be borne by the individual landowners concerned with such cost-sharing assistance as may be available from the Agricultural Stabilization and Conservation Service.

The South Carolina Commission of Forestry, in cooperation with the U. S. Forest Service, will assign a forester to this project for six man-months of work. The cost for this service will be shared by the South Carolina Commission and PL 566. Costs for the first year will be provided from PL 566 funds if the State does not have funds to share in the program. Cost-sharing rates in similar programs will determine the cost-sharing rate during the remainder of the period. The present Cooperative Forest Management program will continue throughout the installation period.

Structural Measures

Federal assistance for establishing the works of improvement as described in this plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (PL 566), as amended. Such financial assistance is contingent on the appropriation of funds for this purpose.

The Willow Swamp Watershed Conservation District is responsible for the "other" share of the cost. Negotiations are underway with the State Director of Farmers Home Administration for a loan to cover the local cost. Although no letter of intent has been filed, the Willow Swamp Watershed Directors have contacted both the local and state offices to indicate that credit will be sought from Farmers Home Administration. It is planned that this loan will be secured by a tax levy on real property.

It is expected that easements will be donated and that necessary changes to roads or bridges will be financed by Colleton County and the South Carolina State Highway Department.

The Act permitting the creation of the Willow Swamp Watershed Conservation District was passed by the South Carolina Legislature in February, 1962. The referendum held on March 13, 1962 for the creation of the Watershed District was favorable with only one dissenting vote. Another referendum is to be held in the future for the purpose of granting additional power of taxation to the Watershed District. Tax levies on lands in the watershed are to be graduated on the basis of the extent to which such lands will be benefited by the project.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be maintained by the farmers on whose lands they are located in accordance with the provisions of their conservation farm plans with the Edisto and Colleton Soil Conservation Districts.

Structural Measures

Structural measures to be operated and maintained consist of 45.9 miles of multiple purpose channel and two fish lagoons. Minor or routine maintenance such as removing debris from channel, suppressing undesirable vegetation with chemicals, and mowing and fertilizing grass will be performed by the farmers on whose lands the improvements are located.

Major maintenance such as periodic clean-outs of the mains and laterals will be performed by the Willow Swamp Watershed Conservation District with funds realized from a tax levy on real property or from other sources. It is expected that Bamberg and Colleton Counties will make labor and equipment available for some of the maintenance work on the channels.

The responsibility for all maintenance on structural measures will be assumed by the Willow Swamp Watershed Conservation District. Specific maintenance agreements will be executed between the Watershed District and the Soil

Conservation Service prior to the issuance of invitation to bid for the construction of structural measures. The estimated average annual cost for operation and maintenance of all structural measures is \$16,600 (Table 4).

Joint inspections of structural measures by representatives of the Soil Conservation Service and the local sponsoring organizations will be made at least once each year or after each major storm, whichever is more often. The Willow Swamp Watershed Conservation District will maintain a record of operation and maintenance inspections in their files. These reports will be made available to interested persons on request. The Soil Conservation Service representative making inspections will prepare a written narrative setting forth his findings.

The South Carolina Commission of Forestry, in cooperation with the U. S. Forest Service, will furnish technical assistance to operate and maintain forestry measures on private lands.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Willow Swamp Watershed, South Carolina

Installation Cost Item (1)	Unit (2)	Number Non-Fed. Land (3)	Estimated Cost (Dollars) 1/			Total (6)
			PL-566 Funds (4)	Other		
				Non-Fed. Land (5)		
Land Treatment						
Soil Conservation Service						
Cropland	Ac.	4,300		36,010		36,010
Grassland	Ac.	2,600		100,150		100,150
Miscellaneous	Ac.	125		3,125		3,125
Technical Assistance			17,576	9,750		27,326
SCS Subtotal			17,576	149,035		166,611
Forest Service						
Woodland	Ac.	5,200		11,300		11,300
Technical Assistance			2,550	1,950		4,500
FS Subtotal			2,550	13,250		15,800
TOTAL LAND TREATMENT			\$20,126	\$162,285		\$182,411

TABLE I - ESTIMATED PROJECT INSTALLATION COST (CONT)

Willow Swamp Watershed, South Carolina

Installation Cost Item (1)	Unit (2)	Number Non-Fed. Land (3)	Estimated Cost (Dollars) 1/ PL-566 Funds Non-Fed. Land Other (4) (5)			Total (6)
			PL-566 Funds (4)	Non-Fed. Land (5)	Other (5)	
<u>Structural Measures</u>						
Soil Conservation Service						
Stream Channel Improvement	L. Ft.	242,352	287,004	73,328		360,332
SCS Sub-total			287,004	73,328		360,332
Sub-total -- Construction			287,004	73,328		360,332
<u>Installation Services</u>						
Soil Conservation Service						
Engineering Services			64,345			64,345
Other			36,098			36,098
SCS Sub-total			100,443			100,443
Subtotal - Installation Services			100,443			100,443
<u>Other Costs</u>						
Land, Easements & R/W				68,600		68,600
Administration of Contracts				2,000		2,000
Subtotal--Other				70,600		70,600
Total Structural Measures			387,447	143,928		531,375
Total Project			407,573	306,213		713,786
<u>Summary</u>						
Subtotal SCS			405,023	292,963		697,986
Subtotal FS			2,550	13,250		15,800
Total Project			407,573	306,213		713,786

1/ Price base: 1963 Prices

Date Jan. 1964

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
Willow Swamp Watershed, South Carolina

Item (1)	Unit (2)	Applied to Date (3)	Total Cost (Dollars) ^{1/} (4)
Conservation Cropping System	Ac.	5,100	\$ 5,100
Cover & Green Manure Crop	Ac.	2,700	23,355
Rotation Grazing	Ac.	1,900	19,000
Pasture Planting	Ac.	1,950	78,000
Wildlife Habitat Development	Ac.	205	5,125
Tile Drain	Feet	5,400	1,944
Drainage Field Ditch	Feet	155,000	31,000
Tree Planting	Ac.	1,660	23,250
Total			\$186,774

^{1/} Price Base - 1962

Date Jan. 1964

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Willow Swamp Watershed, South Carolina
(Dollars) 1/

Structure Site No. or Name (1)	Installation Cost-P.L. 566 Funds				Installation Cost - Other Funds					Total Inst. Cost (11)
	Con- struction (2)	Instal. Services		Total P. L. 566 (5)	Con- struction (6)	Instal- lation Services (7)	Other		Total Other (10)	
		Engin- eering (3)	Other (4)				Adm. of con- tracts (8)	Ease- ments & R/W (9)		
Stream Channel Improvement	287,004	64,345	36,098	387,447	73,328	--	2,000	68,600	143,928	531,375
GRAND TOTAL	287,004	64,345	36,098	387,447	73,328	--	2,000	68,600	143,928	531,375

1/ Price base: 1963 Prices

Date Jan. 1964

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Willow Swamp Watershed, South Carolina

(Dollars) 1/

Item	Purpose		Total
	Flood Prevention	Drainage	
(1)	(2)	(3)	(4)
<u>COST ALLOCATION</u>			
Multiple Purpose Channell Improvement	315,105	216,270	531,375
Total	315,105	216,270	531,375
<u>COST SHARING</u>			
P. L. 566	273,239	114,208	387,447
Other	41,866	102,062	143,928
Total	315,105	216,270	531,375

1/ Price base: 1963 PricesDate Jan. 1964

TABLE 3 - STRUCTURE DATA

CHANNELS

Willow Swamp Watershed, South Carolina

Channel Designation	Sta. Numbering for Reach		Water-shed Area (sq.mi)	Required Drainage Curve	Required Channel Capacity (CFS)	Planned Channel Capacity (CFS)	Bottom Width (Ft.)	Depth (Ft.)	Side Slopes (ft/ft)	Slopes (ft/ft)	"N" Value	Vel. in Channel (ft/sec)	Volume Exc. (cu.yds)
	Sta.	Sta.											
Rum Gully Main	0+00	23+30	0.4	Q=25M5/6	25	149	4	5	1:1	.0024	.045	3.0	
	23+30	35+30	0.6	"	25	149	4	5	"	.0024	.045	3.0	4,290
	35+30	64+00	1.1	"	26	104	4	5	"	.0014	.045	2.3	2,500
	0+00	44+20	0.3	"	25	86	4	5	"	.0011	.045	1.9	
Cedar Main	0+00	30+00	0.3	"	25	95	4	5	"	.0013	.045	2.1	
	30+00	63+34	0.7	"	25	95	4	5	"	.0013	.045	2.1	
	63+34	114+18	1.6	"	37	95	4	5	"	.0013	.045	2.1	7,510
	0+00	11+67	0.2	"	25	77	4	5	"	.0008	.045	1.7	
Lateral No. 1	11+67	41+67	0.6	"	25	77	4	5	"	.0008	.045	1.7	5,400
Lateral No. 2	0+00	41+67	0.4	"	25	121	4	5	"	.0020	.045	2.7	
	41+67	76+67	0.6	"	25	121	4	5	"	.0020	.045	2.7	5,230
Moselle Main	0+00	38+00	0.8	"	25	77	4	5	"	.00052	.045	1.7	
	38+00	113+00	3.0	"	63	77	4	5	"	.00052	.045	1.7	
	113+00	141+34	3.8	"	76	77	4	5	"	.00052	.045	1.7	
	141+34	169+68	4.4	"	84	90	5	5	"	.00052	.045	1.8	
	169+68	221+35	5.1	"	97	108	7	5	"	.00063	.040	1.8	
	221+35	269+69	9.4	"	160	179	12	5	"	.00063	.040	2.1	
	269+69	308+03	12.7	"	211	231	16	5	"	.00063	.040	2.2	
	308+03	331+37	13.4	"	220	231	16	5	"	.00063	.040	2.2	
	331+37	343+04	13.4	"	220	231	16	5	"	.00063	.040	2.2	53,000
	0+00	35+00	0.8	"	25	54	4	5	"	.00040	.045	1.2	
	35+00	70+00	1.5	"	35	54	4	5	"	.00040	.045	1.2	8,685
	0+00	50+00	0.6	"	25	68	4	5	"	.00062	.045	1.5	
	50+00	100+00	0.9	"	25	68	4	5	"	.00062	.045	1.5	14,815
	0+00	58+34	0.8	"	25	191	4	5	"	.0043	.045	3.9	
Lateral No. 3	58+34	110+02	1.6	"	37	191	4	5	"	.0043	.045	3.9	
	110+02	135+02	2.1	"	46	191	4	5	"	.0043	.045	3.9	39,410

TABLE 3 - STRUCTURE DATA CONT.

CHANNELS

Willow Swamp Watershed, South Carolina

Channel Designation	Sta. Numbering for Reach		Water-shed Area (sq.mi.)	Required Drainage Curve	Required Channel Capacity (CFS)	Planned Channel Capacity (CFS)	Bottom Width (ft.)	Depth (ft.)	Side Slopes (ft/ft)	Slopes (ft/ft)	"N" Value	Vel. in Channel (ft/sec)	Volume Exc. (cu.yds)
	Sta.	Sta.											
Lateral No. 4	0+00	27+50	0.2	Q=25M5/6	25	63	4	5	1:1	.00056	.045	1.4	12,280
	27+50	80+85	0.7	"	25	63	4	5	"	.00056	.045	1.4	
Ashton Main	0+00	24+15	0.3	Q=74M5/6	74	85	4	5	"	.0010	.045	1.9	1,370
	24+15	34+15	0.4	"	74	85	4	5	"	.0010	.045	1.9	
Main No. 2	0+00	35+34	0.4	"	74	80	5	5	"	.00053	.040	1.6	26,500 1,730 6,360 8,870
	35+34	70+00	0.8	"	74	135	5	5	"	.0015	.040	2.7	
	70+00	78+70	1.4	"	98	135	5	5	"	.0015	.040	2.7	
	78+70	96+70	1.4	"	98	135	5	5	"	.0015	.040	2.7	
	0+00	16+67	0.1	"	74	149	4	5	"	.0030	.045	3.3	
	0+00	24+18	0.3	"	74	135	4	5	"	.0025	.045	3.0	
	0+00	24+18	0.3	"	74	189	4	5	"	.0050	.045	4.2	
	0+00	21+67	0.4	"	74	85	5	5	"	.00063	.040	1.7	
Main No. 1	21+67	44+17	1.0	"	74	85	5	5	"	.00063	.040	1.7	33,059
	44+17	77+51	2.4	"	149	170	12	5	"	.00063	.040	2.0	
	77+51	95+85	2.6	"	161	170	12	5	"	.00063	.040	2.0	
	95+85	107+85	2.7	"	161	374	12	5	"	.00300	.040	4.4	
	0+00	8+33	0.1	"	74	85	5	5	"	.00061	.040	1.7	
	8+33	37+67	0.5	"	74	85	5	5	"	.00061	.040	1.7	
	37+67	69+34	1.1	"	79	85	5	5	"	.00061	.040	1.7	
	69+34	99+68	1.3	"	91	108	7	5	"	.00061	.040	1.8	
	0+00	26+20	0.5	"	74	75	10	5	"	.00015	.040	1.0	
	26+20	36+20	0.6	"	74	75	10	5	"	.00015	.040	1.0	
Main No. 3	0+00	10+67	0.3	"	74	85	4	5	"	.0010	.045	1.9	18,970
	10+67	39+34	0.6	"	74	85	4	5	"	.0010	.045	1.9	
	39+34	56+00	1.2	"	85	110	5	5	"	.0010	.040	2.2	
	56+00	59+00	1.2	"	85	110	5	5	"	.0010	.040	2.2	
	59+00		1.2	"	85	110	5	5	"	.0010	.040	2.2	
Main No. 4	0+00	10+67	0.3	"	74	85	4	5	"	.0010	.045	1.9	11,550
	10+67	39+34	0.6	"	74	85	4	5	"	.0010	.045	1.9	
Main No. 4	39+34	56+00	1.2	"	85	110	5	5	"	.0010	.040	2.2	11,550
	56+00	59+00	1.2	"	85	110	5	5	"	.0010	.040	2.2	

TABLE 3 - STRUCTURE DATA CONT.

CHANNELS

Willow Swamp Watershed, South Carolina

Channel Designation	Sta. Numbering for Reach		Water-shed Area (sq.mi)	Required Drainage Curve	Required Channel Capacity (CFS)	Planned Channel Capacity (CFS)	Bottom Width (ft.)	Depth (ft.)	Side Slopes (ft/ft)	Slopes (ft/ft)	"N" Value	Vel. in Channel (ft/sec)	Volume Exc. (cu.yds)
	Sta.	Sta.											
Main No. 5	0+00	12+50	0.1	Q=7.4M5/6	74	104	4	5	1:1	.0015	.045	2.3	12,616
	12+50	42+50	0.4	"	74	104	4	5	"	.0015	.045	2.3	
	42+50	64+17	0.7	"	74	104	4	5	"	.0015	.045	2.3	
	64+17	70+17	0.7	"	74	180	4	5	"	.0046	.045	4.0	
Main No. 6	0+00	7+50	0.3	"	74	99	4	5	"	.0014	.045	2.2	3,620
	7+50	32+70	0.6	"	74	99	4	5	"	.0014	.045	2.2	
	32+70	34+70	0.6	"	74	99	4	5	"	.0014	.045	2.2	
	0+00	37+50	0.3	"	74	171	4	5	"	.0041	.045	3.8	
Main No. 7	37+50	79+17	1.0	"	74	171	4	5	"	.0041	.045	3.8	16,670
	0+00	25+00	0.3	"	74	140	4	5	"	.0026	.045	3.1	
	25+00	49+10	0.6	"	74	140	4	5	"	.0026	.045	3.1	
	0+00	22+50	0.2	"	74	88	6	5	"	.0005	.040	1.6	
Main No. 9	22+50	42+50	0.4	"	74	88	6	5	"	.0005	.040	1.6	2,650
	0+00	16+50	0.3	"	74	149	4	5	"	.0031	.045	3.3	
	16+50	42+30	0.8	"	74	149	4	5	"	.0031	.045	3.3	
	42+30	52+60	0.9	"	74	122	4	5	"	.0020	.045	2.7	
Main No. 10	0+00	25+67	0.2	"	74	77	4	5	"	.0008	.045	1.7	8,290
	25+67	40+67	0.5	"	74	77	4	5	"	.0008	.045	1.7	
	0+00	16+67	0.2	"	74	77	4	5	"	.0008	.045	1.7	
	0+00	35+35	0.4	"	74	135	4	5	"	.0025	.045	3.0	
Main No. 11	35+35	68+69	0.6	"	74	180	4	5	"	.0043	.045	4.0	6,457
	0+00	8+00	0.1	"	74	194	4	5	"	.0050	.045	4.3	
	8+00	38+35	0.4	"	74	194	4	5	"	.0050	.045	4.3	
	38+35	53+34	0.5	"	74	171	4	5	"	.0040	.045	3.8	
Lateral No. 1													3,711

TABLE 3 - STRUCTURE DATA CONT.

CHANNELS

Willow Swamp Watershed, South Carolina

Channel Designation	Sta. Numbering for Reach		Water-shed Area (sq.mi)	Required Drainage Curve	Required Channel Capacity (CFS)	Planned Channel Capacity (CFS)	Bottom Width (ft.)	Depth (ft.)	Side Slopes (ft/ft)	Slopes (ft/ft)	"N" Value	Vel. in Channel (ft/sec)	Volume Exc. (cu.yds)
	Sta.	Sta.											
Main No. 12	0+00	26+67	0.3	Q=74M5/6	74	113	4	5	1:1	.0017	.045	2.5	
	26+67	71+67	0.7	"	74	113	4	5	"	.0017	.045	2.5	
	71+67	88+34	0.8	"	74	113	4	5	"	.0017	.045	2.5	
	88+34	113+34	0.9	"	74	113	4	5	"	.0017	.045	2.5	6,000
	0+00	31+67	0.4	"	74	162	4	5	"	.0037	.045	3.6	
Main No. 13	31+67	50+00	0.4	"	74	162	4	5	"	.0037	.045	3.6	11,025
	0+00	22+54	0.2	"	74	90	5	5	"	.0008	.045	1.8	
	22+54	43+34	0.3	"	74	90	5	5	"	.0008	.045	1.8	
	43+34	66+70	0.9	"	74	90	5	5	"	.0008	.045	1.8	
	66+70	68+40	0.9	"	74	90	5	5	"	.0008	.045	1.8	11,240
Main No. 14	0+00	37+54	0.1	"	74	104	4	5	"	.0015	.045	2.3	2,780
	0+00	33+34	0.2	"	74	81	4	5	"	.0009	.045	1.8	
	33+34	40+34	0.2	"	74	81	4	5	"	.0009	.045	1.8	2,945
	0+00	15+00	0.1	"	74	162	4	5	"	.0035	.045	3.6	
	15+00	45+00	0.4	"	74	162	4	5	"	.0035	.045	3.6	
Main No. 15	45+00	67+34	0.5	"	74	122	4	5	"	.0020	.045	2.7	
	67+34	76+51	0.6	"	74	122	4	5	"	.0020	.045	2.7	5,244

Date Jan. 1964

TABLE 4 - ANNUAL COST

Willow Swamp Watershed, South Carolina
(Dollars)

Evaluation Unit	Amortization of <u>1/</u> Installation Cost	Operation and <u>2/</u> Maintenance Cost	Total
(1)	(2)	(3)	(4)
<u>Channel Improvement</u>			
Unit No. 1	559	492	1,051
Unit No. 2	12,396	9,974	22,370
Unit No. 3	2,528	1,873	4,401
Unit No. 4	1,380	1,146	2,526
Unit No. 5	1,128	846	1,974
Unit No. 6	1,888	1,589	3,477
Unit No. 7	775	680	1,455
Total	20,654	16,600	37,254

1/ Price base: 1963 Prices. Amortized at 3 percent interest rate for 50 years.

2/ Long-term prices.

Date Jan. 1964

TABLE 5 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Willow Swamp Watershed, South Carolina
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/					Avg. Annual Cost 2/	Benefit Cost Ratio
	Flood Prevention	Agr. Water Mgt.	Re-develop-ment	Total			
	More Intensive Land Use	Drainage					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	
<u>Channel Improvement</u>							
Unit No. 1	1,825	1,252	123	3,200	1,051	3.0 to 1.0	
Unit No. 2	33,048	22,683	2,223	57,954	22,370	2.6 to 1.0	
Unit No. 3	5,424	3,723	365	9,512	4,401	2.2 to 1.0	
Unit No. 4	3,295	2,261	222	5,778	2,526	2.3 to 1.0	
Unit No. 5	2,281	1,566	153	4,000	1,974	2.0 to 1.0	
Unit No. 6	3,294	2,261	222	5,777	3,477	1.7 to 1.0	
Unit No. 7	1,521	1,044	102	2,667	1,455	1.8 to 1.0	
GRAND TOTAL	50,688	34,790	3,410	88,888 ^{3/}	37,254	2.4 to 1.0	

1/ Price base: Long-term projected.

2/ See Table 4.

3/ Does not include secondary benefits of \$15,162 annually.

Date Jan. 1964

INVESTIGATIONS AND ANALYSESSedimentation and Erosion

Reconnaissance, prior knowledge of the general area, and a brief study were sufficient to indicate that problems arising from erosion or accumulation of sediment are not serious enough to warrant detailed study or evaluation. Field windbreaks and wind-stripcropping are being included in the plan to reduce wind erosion.

Geologic

Study of available literature, reconnaissance, and hand auger exploration during the preliminary investigation period indicated soil and foundation conditions which would be conducive to considerable seepage loss and would result in excessive costs for installation of irrigation reservoirs. These factors, along with others, resulted in the abandonment of preliminary plans for such reservoirs.

Foundation conditions along the centerline of a proposed recreation reservoir were explored with a rotary drill. It was concluded from these borings that seepage would be considerable and that a positive cutoff could not be obtained. The reservoir subsequently was deleted from the plan because of cost and the anticipated detrimental effect of the reservoir on the Hampton and Branchville Railroad fill.

A number of hand auger borings was made in areas of proposed channel installation. The information thus obtained led to the opinion that ditches of more than five-foot depths probably could not be installed and maintained satisfactorily because of loose sand and high water table. The unstable soils will cause some sloughing of channel side slopes. It was concluded also that owing to the same factors double-cutting will be needed to install many of the planned channels. These opinions were strengthened and supported by the experiences of engineers in the general area.

Landowners have expressed a desire to install tile wherever it can be used. The soils found in the watershed will prevent the construction of channels with depths that will accommodate tile drains except in limited areas.

Engineering

Mean sea level datum was used for vertical control throughout the watershed. Temporary bench marks were established near the planned channels.

Channel cross sections were made approximately one-half mile apart on all of the new channels. Elevations of all bridges, culverts, and other control points were established. Profiles of the planned channels were made showing the present ditches, average ground elevations, and control points. These data were used for preliminary channel design as outlined in the National Engineering Handbook, section 16, chapter 6. Distances were measured from aerial photographs. Photo mosaics were used for locating the farm boundaries, and layout of the planned structural measures. The channels were numbered according to the National Engineering Handbook, section 16, chapter 2.

All data has been recorded and filed for final layout and design of the channels.

Hydraulic and Hydrologic

Elevation-discharge curves for each of eleven valley cross sections were developed using Manning's formula.

The present and future weighted average soil cover complex curve numbers for the watershed were calculated from information that was received from the area Soil Scientist, local Soil Conservationist and U. S. Forest Service.

An array of rainfall was prepared using data from the Yemassee, S. C. rain gage. Runoff amounts for this array were determined by using the future weighted average curve number for the watershed, and a runoff frequency curve was plotted from this information.

To meet the project objective of two year level of protection in the Moselle,

Cedar, and Rum Gully Swamp areas and a five year level of protection on the remainder of the area, the coefficients for the formula $Q=CM^{5/6}$ were computed and found to be twenty-five and seventy-four. This is a removal rate of .93 inches in forty-eight hours from one square mile in the Moselle, Cedar, and Rum Gully Swamp areas and 2.75 inches in twenty-four hours from one square mile in the remainder of the area. Design discharges were determined on these bases to facilitate channel design.

Soil Conditions

Soil conditions were determined through study of soil survey maps and field examination. General locations for the primary drainage system were determined by spotting problem areas on the maps.

Land Use and Treatment

The existing pattern of land use was determined from soil conservation surveys and field study. Estimates of future land use and treatment measures were made by work unit conservationists on the basis of their knowledge of the people, the land and present trends. Land capabilities and needs were considered in compiling the list of land treatment measures shown in Table 1.

Forestry

A systematic field survey showed ground cover, forest and hydrologic conditions, and treatment needs. This survey, supporting data, and information from other agencies and forestry officials determined the amount of remedial measures. The installation period limits the amount of work in the recommended program. These measures include only those which contribute directly to flood reduction and soil stabilization.

Economic

Methods used in making the economic investigations and analyses followed those approved by the Soil Conservation Service in benefit-cost evaluations on land and water resource projects. Basic data were obtained from local farmers,

agricultural workers, experiment stations, and Department of Agriculture publications.

Long-term projected prices were derived from data furnished by the Agricultural Research Service and Agricultural Marketing Service, dated September 1957. Projected prices were used in all benefit computations as well as for operation and maintenance costs. Present (1963) prices were used for installation costs. The cost of all structural measures was amortized over a 50 year period, using a three percent interest rate.

Land use and yield information used in the economic evaluation was obtained from interviews with farmers who operate approximately 25 percent of the affected open land in the watershed. Soil maps were used in connection with these interviews. This information was evaluated for reasonableness and summarized. This information was also checked with data from the County Agricultural Stabilization and Conservation Service office on farms representing approximately 55 percent of the open land in the watershed. (Re: Alloted crops)

The estimated value of land, easements, and rights-of-way for structural measures is \$68,600. Included in this amount is \$1,000 for legal fees and local time spent in obtaining and recording easements and \$49,000 for the cost of altering road culverts and bridges. The estimated value of land was furnished by the local organizations. The South Carolina State Highway Department provided basic data for cost estimates of altering road culverts and bridges.

Inseparable flood prevention and agricultural water management benefits to crops and pasture were estimated on the basis of the difference in net returns with and without the project. Details of calculating estimated joint enhancement benefits are shown in the table on page 36. These benefits were allocated to flood prevention and to agricultural water management (drainage) in the same proportion that costs were allocated (59.3 percent to flood prevention and 40.7 percent to agricultural water management).

The U. S. Forest Service made a study of the forest land in the watershed. They estimate that landowners will intensify proper forest management practices on 3,600 acres of forest land which have a water control problem. Details of calculating these benefits are shown in the table on page 36.

Secondary and Redevelopment benefits were estimated in accordance with provisions in Watersheds Memorandum SCS-57, dated October 3, 1962. Secondary benefits were not used for project justification.

Construction cost of multiple purpose structural measures for flood prevention and agricultural water management were allocated to each purpose in accordance with the method prescribed in paragraph 1132.212h of the Watershed Protection Handbook as follows:

- (1) A portion of multiple purpose costs was allocated to flood prevention equivalent to the ratio of non-wet land to total area served by multiple purpose channels.
- (2) The remaining costs were considered as joint cost and were allocated equally between flood prevention and agricultural water management.

These steps provided the following percentages:

a. Percent non-wet land is of total	18.6
b. Percent joint cost is of total	81.4
c. One-half of joint cost (%)	40.7
d. Percent cost allocated to flood prevention	59.3
e. Percent cost allocated to agricultural water management	40.7

- (3) Estimated construction cost of multiple purpose channel \$360,332
- (4) Amount of construction cost allocated to flood prevention (59.3% of \$360,332) \$213,677
- (5) Amount of construction cost allocated to agricultural water management (40.7% of \$360,332) \$146,655

Details of cost-sharing arrangements are as follows:

<u>Multiple Purpose</u>	<u>P.L. 566</u>	<u>Other</u>	<u>Total</u>
Construction cost (F.P.)	\$213,677	\$ 0	\$213,677
Construction cost (A.W.M.)	73,327	73,328	146,655
Installation Services			
Engineering	64,345	0	64,345
Other	36,098	0	36,098
Administration of contracts	0	2,000	2,000
Land, Easements, & R/W	0	68,600	68,600
Total	\$387,447	\$143,928	\$531,375

Summary of Joint Enhancement Benefits
Willow Swamp Watershed, South Carolina
(Dollars) 1/

Without Project Conditions				With Project Conditions			
Land Use	Acres	Weighted Av. Yield	Net Returns	Land Use	Acres	Weighted Av. Yield	Net Returns
Cotton	811	430 #	\$ 35,684	Cotton	811	650 #	\$ 60,014
Corn	2,147	45 bu.	55,822	Corn	2,147	65 bu.	94,468
Soybeans	1,169	18 bu.	28,056	Soybeans	1,169	28 bu.	52,605
Tobacco	24	1,675 #	6,480	Tobacco	24	2,000 #	8,880
Oats	143	40 bu.	1,287	Oats	143	60 bu.	3,575
Idle	95	--	--	Idle	--	--	--
Pasture	383	3 AUM	3,447	Pasture	478	5 AUM	7,170
Oats	(620)	40 bu.	5,580	Oats	(620)	60 bu.	15,500
Total	4,772 <u>2/</u>	xxx	\$136,356	Total	4,772 <u>2/</u>	xxx	\$242,212

Increased Net Returns \$105,856
Discounted Difference in Net Returns 94,900 3/
Less Added Farm Drainage Cost 18,062
Average Annual Benefits (Crops) 76,838
Forest Benefits which will result from flood control and drainage 8,640 4/
Average Annual Benefits \$ 85,478

1/ Price base: Long-term projected.

2/ Reduced 30% for lack of participation.

3/ 50% of Increased Net Returns discounted for delay in accrual at 5% for 10 years.

4/ The U. S. Forest Service estimates the benefited area could be 7,200 acres with 100 percent program participation; however, they expect only 50 percent participation. Annual primary benefits are estimated to be \$2.40 per acre on 3,600 acres.

The project was divided into seven evaluation units as follows: (See project map for proposed Channel Improvement)

- | | |
|-------------------|---|
| <u>Unit No. 1</u> | Includes Rum Gully Main and Lateral No. 1 |
| <u>Unit No. 2</u> | Includes Cedar Main and Laterals No. 1 & 2; Moselle Main and Laterals No. 1, 2, 3, & 4; Ashton Main; Main No. 2 and Laterals No. 1, 2, and Sub Lateral No. 1; Main No. 1 and Lateral No. 1; Main No. 3. |
| <u>Unit No. 3</u> | Includes Mains No. 4, 5, 6, 14, and 15. |
| <u>Unit No. 4</u> | Includes Mains No. 7, 8, and 9. |
| <u>Unit No. 5</u> | Includes Main No. 10 and Lateral No. 1; Main No. 10B. |
| <u>Unit No. 6</u> | Includes Main No. 11 and Lateral No. 1; Main No. 12 and Lateral No. 1. |
| <u>Unit No. 7</u> | Includes Main No. 13 and Lateral No. 1. |

Fish and Wildlife

Species of wildlife consist primarily of quail, doves, rabbits and squirrels. There are smaller populations of deer and wild turkey. Fishing opportunities in the watershed are somewhat limited.

The installation of two fish lagoons are planned for the watershed. It is expected that these will mitigate possible damages caused by interference with the natural fish habitat when the canal system is constructed.

The lagoons will be excavated 20 feet by 300 feet and will be located near the multiple purpose channels so that a connecting ditch may be provided.

Locations of the lagoons are shown on the project map.



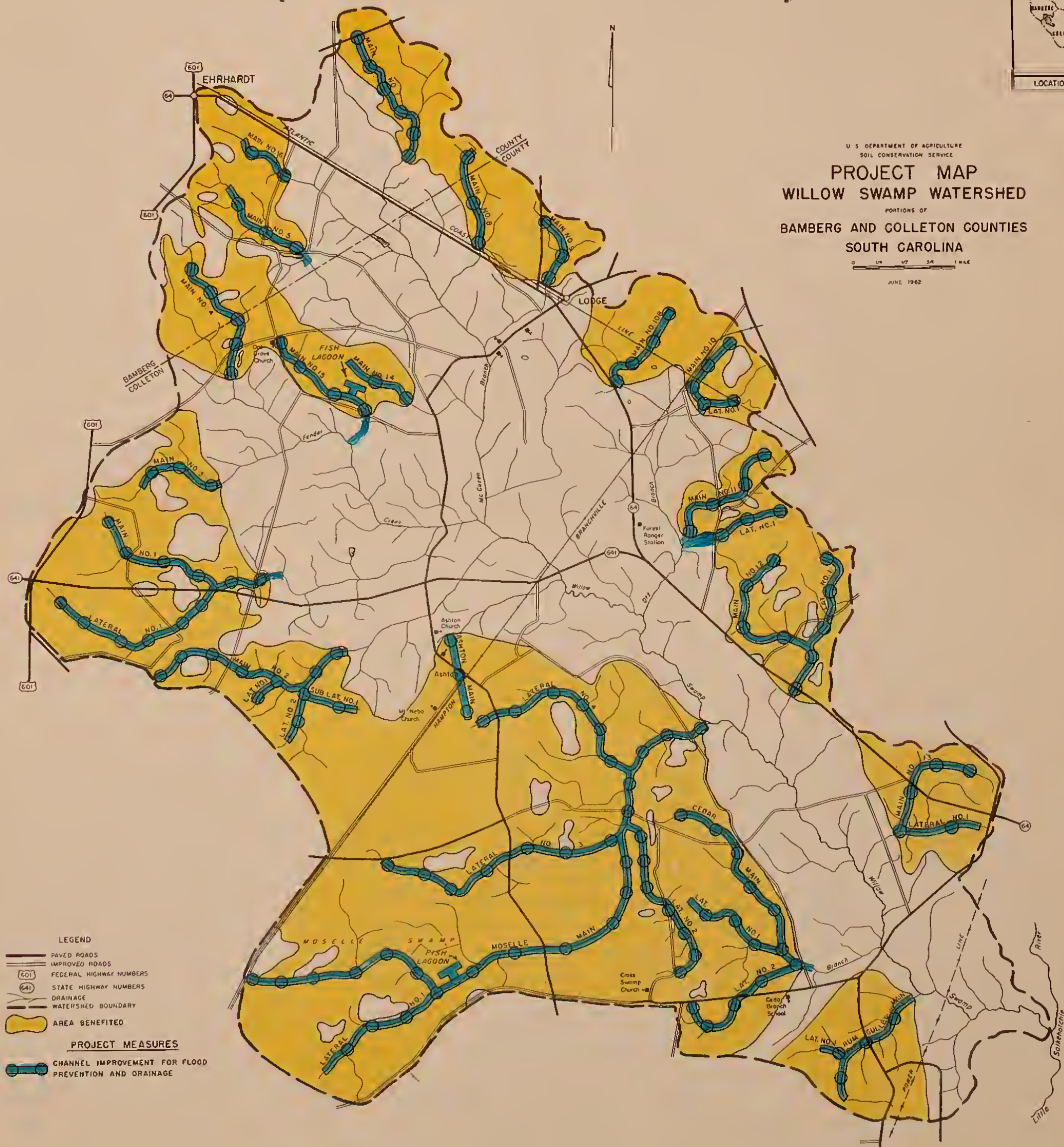
LOCATION MAP

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT MAP WILLOW SWAMP WATERSHED PORTIONS OF BAMBERG AND COLLETON COUNTIES SOUTH CAROLINA

0 1/4 1/2 3/4 1 MILE

JUNE 1962



LEGEND

- PAVED ROADS
- IMPROVED ROADS
- FEDERAL HIGHWAY NUMBERS
- STATE HIGHWAY NUMBERS
- DRAINAGE
- WATERSHED BOUNDARY
- AREA BENEFITED

PROJECT MEASURES

- CHANNEL IMPROVEMENT FOR FLOOD PREVENTION AND DRAINAGE

LATITUDE AND LONGITUDE LINES ARE APPROXIMATE

DECEMBER 1963

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